

# Exploring the role of daily “modality styles” and urban structure in holidays and longer weekend trips: Travel behaviour of urban and peri-urban residents in Greater Copenhagen



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## ABSTRACT

In the course of climate change and sustainable development, changing travel behaviour marks a cornerstone towards reducing the negative impacts of CO<sub>2</sub>-emissions and resource exploitation. The differences in daily travel (e.g., commute to work) between urban and peri-urban areas have been comprehensively researched. However, other travel domains (e.g., occasional weekend trips or holidays) have only recently received more attention, despite their environmental impact.

The paper investigates whether and how *daily* travel patterns (“modality styles”) correspond with *non-daily* travel behaviour such as holidays and longer weekend trips in order to establish a more comprehensive understanding of the role of urban structure in travel behaviour across different travel domains.

The study is based on a questionnaire survey, which was conducted in an urban district in central Copenhagen and a small town in the commuter belt of Greater Copenhagen in spring 2016. First, we identify “modality styles” by grouping the sample based on the respondents’ daily mode choices. Second, we relate the identified modality styles to socio-economic and socio-demographic factors, frequency and mode choice of longer weekend trips and holidays, and travel-related attitudes.

The results reveal that the urban structure of a residential location (e.g., urban vs. peri-urban) exerts to some extent influence on the constitution of daily modality styles. We found, furthermore, a tendency for more weekend trips and holidays among the urban sample; we interpret this as interdependency between modality style, residential location, car ownership/use, and plane use expressed in certain travel behaviour.

## 1. Introduction

Previous research has established the importance of urban structure for daily travel behaviour. Urban settings are associated with short distances due to compact spatial structures and mixed urban functions that facilitate reduced travel demand and more sustainable mode choices. In contrast, peri-urban or rural areas are supposed to encourage less sustainable travel behaviour (e.g. Ewing and Cervero, 2010; Fertner and Große, 2016; Næss, 2012; Nielsen et al., 2013). Hence, urban structure defines “exogenous baseline conditions provided for travel choice”, but “socioeconomic and demographic characteristics provide the individual/household setting in which travel choices are finally made” (Silva et al., 2015, p. 24).

However, research on travel behaviour has to date predominantly focused on shorter daily travel (Kristensen et al., 2014) or travel as a matter of routine (Vilhelmson, 2007). This entails that certain travel domains related to many types of (occasional) leisure activity (e.g.,

weekend trips or holidays), which are typically more flexible in time and place (Vilhelmson, 2007), and their drivers and characteristics remain understudied.

Only recently has leisure travel, particularly occasional long-distance travel, received more attention; this is highly recommended, considering its extent and environmental impact. In the more wealthy Western European countries, long-distance travel ( $\geq 100$  km) accounts for probably almost 50% of greenhouse gas emissions from travel (van Goeverden et al., 2016). Moreover, international tourism is steadily increasing, having reached 640 million arrivals by plane in 2015 (World Tourism Organization, 2016).

The explanatory factors that underlie travel behaviour, such as urban structure, socio-demographic and socio-economic factors, residential preferences, lifestyle, or attitudes are interrelated but have different significance in different travel domains (e.g. van Acker et al., 2010).

The aim of the paper is (1) to investigate whether and how *daily*

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travel patterns (“modality styles”) correspond with frequency and transport mode choice of *holidays and longer weekend trips*, and (2) to investigate how this potential correspondence might reflect the role of urban structure in constituting travel behaviour across these travel domains.

We conduct a comprehensive analysis of travel behaviour by including daily travel patterns on the one hand and longer weekend trips (> 30 km, max. 3 nights) and holidays (> 3 nights) on the other hand. Consequently, we aim to challenge and refine the traditional dichotomy between urban and peri-urban settings in terms of travel patterns in order to better understand what constitutes sustainable travel behaviour.

## 2. Modality styles and residential self-selection

Taking their point of departure from the idea of market segmentation or customer classification (Diana and Mokhtarian, 2009), travel behaviour studies have increasingly applied segmentation approaches to identify homogeneous population groups. Certain similar attributes are deemed relevant for explaining travel behaviour and support, furthermore, relating travel patterns to different spatial settings (Barr and Prillwitz, 2012; Haustein and Hunecke, 2013).

Haustein and Hunecke (2013) distinguish between four basic segmentation approaches in travel behaviour research: segmentation based on *actual travel behaviour* (e.g. Prillwitz and Barr, 2011), *geographical variables* (e.g. Scheiner, 2006), *socio-demographic characteristics* (e.g. Ryley, 2006), *travel-related attitudes and values* (e.g. Anable, 2005; Barr and Prillwitz, 2012; Ohnmacht et al., 2009; Prillwitz and Barr, 2011) or a combination of the above (e.g. Jensen, 1999).

*Travel behaviour-based* approaches, as applied in this study, are also conceptualised as “modality styles” that are understood as “behavioral predispositions, characterized by a certain travel mode or set of travel modes that an individual habitually uses” (Vij et al., 2013, p. 165). Modality styles are considered here as an expression of *mobility styles* (Olafsson et al., 2016; Vij et al., 2013), a wider concept that facilitates relating travel behaviour to socio-economic characteristics and moreover to lifestyles, personal preferences or attitudes (Barr and Prillwitz, 2012; Haustein and Hunecke, 2013; Krueger et al., 2016). The relationship between travel behaviour and lifestyle is based on an understanding that lifestyle orientations (e.g., family life, attitudes) manifest themselves in “observable patterns of behaviour”; i.e. patterns of travel behaviour can be understood as lifestyle expressions (van Acker et al., 2016, p. 27).

Some studies have used segmentation approaches for investigating leisure travel, either solely or related to other types of travel: The results of a German study suggest that mobility styles in weekend leisure travel largely explain distances travelled by car, and that car ownership and preferences for car use for leisure travel turn out as mutually reinforcing factors (Lanzendorf, 2002). A Norwegian study that focused on connections between daily travel patterns and long-distance travel found differences in relation to people's life stage, workforce participation and overall travel activity (Julsrud, 2014). A study from the UK applied a novel approach by comparing two segmentations, one based on daily travel patterns and a second one based on travel-related attitudes and environmental values. This revealed discrepancies between attitudes and reported holiday travel behaviour (Prillwitz and Barr, 2011). Further studies have shown deviations between travel-related attitudes and actual leisure travel behaviour (e.g. Böhler et al., 2006; Holden, 2007). Hence, attitudes are a useful parameter to qualify self-reported behaviour.

Existing academic literature and empirical work indicate, furthermore, a tendency for more distant and more frequent long-distance leisure travel among city dwellers (e.g. Frändberg and Vilhelmson, 2003; Holz-Rau et al., 2014; Reichert et al., 2016); however, if this correspondence is linked to urban structure remains to be determined.

In order to reflect upon the role of urban structure (e.g., urban vs.

peri-urban) across different travel domains, we consider *residential self-selection* when interpreting the results. “Residential self-selection” supposes that people make residential choices (e.g., for a certain urban structure) in accordance with their travel dispositions (Bohte et al., 2009; de Vos and Witlox, 2016; Mokhtarian and Herick, 2016; van Acker et al., 2010; van Wee, 2009), which are determined by attitudes and socio-demographic or socio-economic factors (e.g., income) (Mokhtarian and Cao, 2008). This implies that people's travel-related attitudes and preferences may have a strong influence on travel behaviour and may lead to flawed assessments of the influence of urban structure due to a misinterpretation of observed associations between urban structure (i.e. residential location) and travel behaviour (Cao et al., 2009; Mokhtarian and Cao, 2008). Although urban structure has, generally speaking, been found to affect travel behaviour (Mokhtarian and Herick, 2016; Næss, 2012; Næss, 2009), the results regarding the magnitude of its influence on travel behaviour when controlling for self-selection vary considerably, in part depending on the applied methods (Cao et al., 2009; Mokhtarian and Herick, 2016).

However, in contrast to residential self-selection, people may for various reasons (e.g., income, distance to workplace) need to reside in a location that does *not* accommodate their travel dispositions. This is conceptualised as *residential dissonance* or *mismatch* (de Vos et al., 2012). Consequently, people might have preferred travel modes that do not match (e.g., private car in the city) or are not available (e.g., public transport in rural areas) at their residential location (de Vos et al., 2012; Schwanen and Mokhtarian, 2005a). In these cases, urban structure is considered a constraining factor for adjusting travel mode choices of “mismatched” residents (Cao et al., 2009; de Vos et al., 2012; Schwanen and Mokhtarian, 2005b).

Considering residential self-selection, thus, proves useful for distinguishing the influence of the urban structure of a residential location on travel behaviour from the influence of other factors (e.g., socio-economic factors, preferences or lifestyles) that might simply be expressed in residential choices and, hence, “disguised” as urban structure.

## 3. Methods and data

The paper is based on a questionnaire survey carried out in May and June 2016 in Østerbro (Copenhagen municipality) and Borup (Køge municipality, both Denmark).

The chosen analytical approach was inspired by the work of Prillwitz and Barr (2011) and Julsrud (2014). We segmented the respondents of the two case areas, based on self-reported daily mode choices (work and free time), and related the identified *modality styles* to socio-economic and socio-demographic parameters, weekend and holiday travel behaviour, and travel-related attitudes.

### 3.1. Study cases

Østerbro is an inner district of Copenhagen with about 76,800 inhabitants in March 2016 (Kommune, 2016) and an area of 8.74 km<sup>2</sup>. Borup is a small town with about 4600 inhabitants in 2016 (Denmark, 2016) and an area of 2.6 km<sup>2</sup>. Borup is located about 55 km southwest of central Copenhagen and thereby in daily commuting distance (by car or public transport) to Copenhagen as well as to Roskilde, the second largest city on Zealand with a distance of about 20 km north of Borup (see Fig. 1).

Østerbro and Borup can be considered “paradigmatic” cases in terms of urban structure: They represent two distinct types of living environment in terms of urban structure. The dense urban district of Østerbro in Copenhagen represents ‘central urban living’, characterised by middle- to high-income residents with higher educations, i.e. possibly with a preference for travelling. The small town of Borup in Copenhagen's commuter belt represents ‘peri-urban small town living’, attracting young families who move out of the city. The cases show

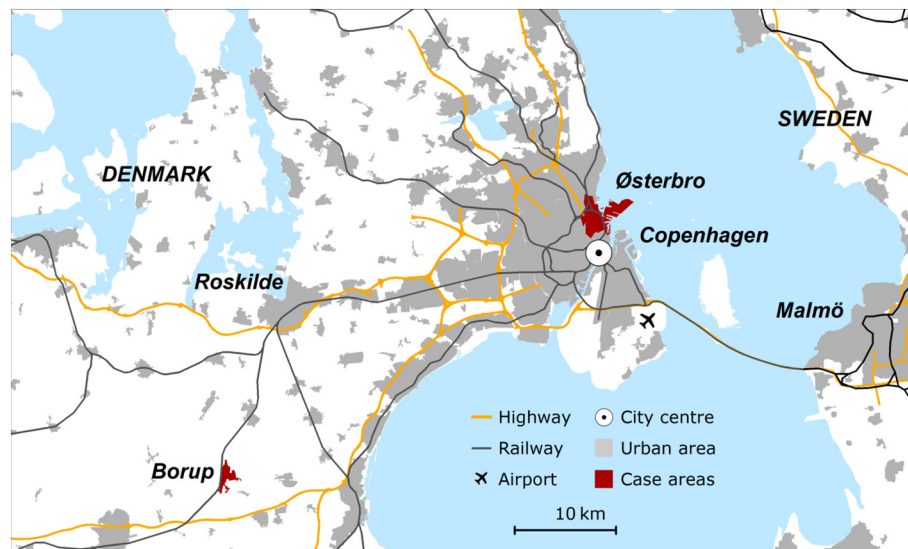


Fig. 1. Map of case areas (data source: Kort 10, Danish Agency for Data Supply and Efficiency).

comparable socio-economic profiles (e.g., income, workforce participation), which allows maximising the explanatory power of urban structure and further factors, such as attitudes.

Choosing two cases from within the Greater Copenhagen Region facilitates control for “meta-conditions” such as geographic context and general welfare level while highlighting the spatial component of the analysis and providing direct comparisons between travel patterns of urban and peri-urban residents, which is a core contribution of this study.

### 3.2. Sampling method (survey)

The questionnaire survey was carried out online; given an internet penetration rate of 94% in 2016 in Denmark (European Commission, Eurostat, 2016) and the age target group (18–65 years), this was judged as an appropriate method.

In Østerbro the questionnaire was distributed via e-mail to 757 households (including a reminder e-mail) using an online panel provider. The response rate of completed surveys was 31.7%. As panel providers cannot offer sufficient sample sizes outside the big cities, in Borup each household, except housing for elderly people and nursing homes, received a non-personalised written invitation with a link to the online questionnaire (1874 households in total), however, not including a reminder letter. We placed additional advertisements in the local newspaper, library, and supermarkets to promote and access the survey. The response rate of completed surveys was 9.3%, which can be considered sufficient (confidence level = 95%, confidence interval = 7%).

The questionnaire had to be answered by one person per household, aged between 18 and 65 years, to focus on the working population; respondents outside this age group were included if they were part of the working population. The final sample consisted of 239 complete responses in Østerbro and 157 in Borup. Furthermore, we included 23 partially complete responses in Østerbro and 20 in Borup in the final sample, totalling 439 responses.

The Borup sample deviated slightly from the town's age structure with an overrepresentation of respondents between 45 and 64 years. The Østerbro sample deviated from the district's age and gender structure (underrepresentation of younger and overrepresentation of older population, overrepresentation of women); see Table 2 and Table 5.

### 3.3. Variables and statistical analysis

For designing the questionnaire, we considered previous studies on travel behaviour and nationwide statistics such as *The Danish National Travel Survey* (Christiansen and Skougaard, 2015) and *Statistics Denmark*. Other than commonly applied in travel surveys, people were not asked about yesterday's trips but about their ‘usual’ behaviour (related to the last 12 months) to avoid seasonal bias as the sampling period was limited to spring 2016. Table 1 summarises the variables used for the statistical analysis.

We applied descriptive statistics for an initial characterisation of the studied variables. The main statistical analysis consisted of two steps: (1) grouping the complete sample in *modality styles*, and (2) comparing the *modality style*-groups in terms of their characteristics (identifying group differences).

The grouping of the respondents in modality styles (see Table 1) was based on the respondents' *primary transport mode to work/education* (cycling, car, public transport, other) and the *transport mode(s) to get to free-time activities in daily life* (walking, cycling, car, public transport). We only considered responses that had valid values for both transport mode to work and free-time activities; totalling 339 responses.

For an initial assessment of a purposeful grouping, we conducted agglomerative hierarchical clustering with Ward's method and squared Euclidian distance, a commonly used approach in hierarchical clustering (Mooi and Sarstedt, 2010), using IBM SPSS Statistics 24. Due to the limitations of hierarchical clustering when using binary variables, we also applied SPSS' TwoStep clustering (log-likelihood criterion) as an alternative procedure (Schendera, 2010), using the same variables as for the hierarchical clustering. On the basis of the clusters suggested by the hierarchical and the TwoStep procedure, we conducted the final grouping of respondents into *modality styles* by manually combining the results of both procedures. This allowed for accurate representation of mode choices as the basis for assignment of *modality styles*, which could not be achieved through the statistical procedures, especially with regard to *public transport users* and *mixed private transport users*. It furthermore helped minimise outliers.

Subsequently, we compared the *modality styles* created in the grouping process to identify significant differences between the groups for a set of parameters (see Table 1). To account for the spatial dimension of the sample, we additionally split the two groups that share a mix of respondents from both case areas into their (a) Østerbro and (b) Borup subsamples (hereafter referred to as 2a/3a for Østerbro and 2b/

**Table 1**  
Variables used in statistical analysis.

	Variable	Variable values
Grouping “modality styles”	Primary (combined <sup>a</sup> ) transport mode to work/education	Cycling/car/public transport/other (single choice)
Group differences	Multiple transport mode(s) <sup>b</sup> to get to daily life free-time activities	Walking/cycling/car/public transport (multiple choice)
	Location before moving (if moved within the last 5 years)	urban/non-urban
	Age	years
	Highest completed level of education	Primary or upper secondary education/Vocational or short-cycle higher education/Medium- or long-cycle higher education
	Household size (total no. of adults and children)	1 person/2 persons/3 persons/4 persons/5 or more persons
	Number of adults per household	1 adult/2 adults/3 adults/4 or more adults
	Number of children per household	None/1 child/2 children/3 children/4 or more children
	Household form	Single/single with 1 or more children/couple without children/couple with 1 or more children
	Income per person per household (incl. adults and children)	Danish kroner (Ln)
	Distance to workplace or place of education	kilometres (Ln)
	Number of cars per household	None/1 car/2 or more cars
	Number of weekend trips (max. 3 nights) in Denmark/Skåne, outside Denmark/Skåne <sup>c</sup> within the last 12 months	None/1–2 trips/3–5 trips/6 trips or more
	Number of holidays (> 3 nights) on Zealand, elsewhere in Denmark, elsewhere in Scandinavia, elsewhere in Europe, outside Europe within the last 12 months	None/1–2 trips/3–5 trips/6 trips or more
	Total number of holidays (> 3 nights) within the last 12 months	Number of trips
	Transport mode <sup>d</sup> to last weekend trip (max. 3 nights) in Denmark/Skåne, outside Denmark/Skåne	Car/public transport/plane/other (single choice)
	Frequency of different transport modes (car, ferry, train/bus, plane, other) to holidays (> 3 nights) within the last 12 months	Never/1–2 times/3–5 times/6 times or more
	Total number of private plane trips (weekend trips and holidays) within the last 12 months	None/1–2 trips/3–5 trips/6 trips or more
	Statements on travel-related attitudes:	3-point Likert scale <sup>e</sup> : 1 - (strongly) agree/2 - neither/nor/3 - (strongly) disagree
	“Owning a car gives me freedom to go where- and whenever I want.”	
	“It is important for me that my transport mode in daily life is environmentally friendly.”	
	“It is important for me that my transport mode to weekend trips and holidays is environmentally friendly.”	
	“Weekend trips and/or holidays are important for me.”	

<sup>a</sup> The respondents were asked to select the different transport modes they combine in *one* journey. Thus, “primary transport mode to work” includes also combined modes; in these cases the predominant mode was considered as primary mode (e.g., bicycle and public transport: public transport is primary).

<sup>b</sup> Transport mode choices in free time are considered more flexible/changeable; therefore, they are included as multiple choices

<sup>c</sup> Skåne (English: Scania) is the southernmost county of Sweden, which can be considered as part of the Greater Copenhagen Region based on distance.

<sup>d</sup> Primary transport mode if multiple modes were combined (e.g., public transport and plane: plane is primary).

<sup>e</sup> The survey question used a 5-point Likert scale that was later aggregated to a 3-point scale.

3b for Borup) and also explored the group differences for this extended grouping. The tables in the following section summarise the results for which significant group differences exist, the complete results are included in the supplementary material at the end of the paper.

For the group differences, we applied *Pearson's Chi-square test* with post-hoc pairwise comparisons using the *z*-test of two proportions with a Bonferroni correction for categorical variables (Laerd Statistics, 2016), and *Kruskal-Wallis H* with post-hoc pairwise comparisons using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons for ordinal and continuous variables (Laerd Statistics, 2015); the statistical tests were conducted in IBM SPSS Statistics 24 and XLSTAT 2017.

The assumption of independence of observations was met as each respondent can only belong to one modality style group, and the respondents are further unrelated as only one person in each household answered the questionnaire.

## 4. Results

Table 2 provides a brief overview of the main socio-economic and socio-demographic characteristics of the sample, distinguished in terms of the two case areas, Østerbro and Borup:

The two samples are distinctive in terms of household size, particularly the number of children, and – accordingly – income per person. Borup is characterised as a residential location for younger families with children, with comparatively higher income per household, but, due to the number of children, lower income per person compared to Østerbro. Østerbro, in contrast, shows a higher share of smaller household forms without children (see also Table 5).

These specific background characteristics of the sample, which respond to the selection criteria of the study cases, are crucial for interpreting the results with regards to travel behaviour.

### 4.1. Daily travel behaviour (modality styles)

The hierarchical clustering suggested five meaningful clusters of modality styles. The TwoStep procedure identified similar clusters; however, it also extracted a high number (108) of outliers. The final manual grouping of the respondents is composed of four modality styles (see Table 3):

- Group 1 – *Committed cyclists* use the bicycle both to commute to work and in their free time (additionally, other transport modes in free time);
- Group 2 – *Public transport users (work)* use public transport to commute to work, but a mix of transport modes for getting to free-time activities;
- Group 3 – *Mixed private transport users* use a mix of modes but never public transport, neither to work nor to free-time activities;
- Group 4 – *“Die-hard” car drivers*<sup>1</sup> exclusively use the car both to commute to work and in their free time.

Only few outliers (14) that do not belong to any of the four groups remained; the outliers were excluded from the analysis of group differences.

<sup>1</sup> Term based on Anable (2005).

**Table 2**  
Sample characteristics Østerbro and Borup.

		Østerbro		Borup	
		Frequency	n %	Frequency	n %
Gender	Female	176	67.2%	86	48.6%
	Male	86	32.8%	91	51.4%
		Mean	SD	Mean	SD
Age		49.57	11.74	45.67	12.61
Level of education	Primary or upper secondary education	25	10.5%	23	14.7%
	Vocational or short-cycle higher education	44	18.4%	44	28.2%
	Medium- or long-cycle higher education	170	71.1%	89	57.1%
		Mean	SD	Mean	SD
Income per HH (DKK)		579,851	295,262	690,071	275,047
		Frequency	n %	Frequency	n %
Household size (no. of persons)	1	88	38.3%	27	17.6%
	2	85	37.0%	41	26.8%
	3	28	12.2%	32	20.9%
	4	21	9.1%	41	26.8%
	5 or more	8	3.5%	12	7.8%
Number of adults per household	1	102	44.3%	42	27.5%
	2	108	47.0%	92	60.1%
	3	17	7.4%	17	11.1%
	4 or more	3	1.3%	2	1.3%
Number of children per household	None	178	77.4%	70	45.8%
	1	26	11.3%	35	22.9%
	2	20	8.7%	37	24.2%
	3	5	2.2%	9	5.9%
Income per person per HH (DKK)	4 or more	1	0.4%	2	1.3%
		315,974	158,629	282,901	156,152
		Frequency	n %	Frequency	n %
Number of cars per household	None	125	47.7%	16	9.1%
	1	123	46.9%	97	55.4%
	2 or more	14	5.3%	62	35.4%
		Mean	SD	Mean	SD
Distance to workplace (in km)		8.68	10.19	41.03	20.50

Table 4 provides an overview of the four modality styles and how they are represented in Østerbro and Borup. Group 1 (*committed cyclists*) is almost 97%-represented in Østerbro, and group 4 (*“die-hard” car drivers*) is represented by > 76% in Borup; groups 2 and 3, in contrast, share a mix of respondents from both case areas.

#### 4.2. Socio-economic and socio-demographic group differences

The socio-economic and socio-demographic differences between the groups are particularly expressed when accounting for the residential location (see Table 5). Group 1 shows the significantly highest education level, in particular compared to groups 2a, 2b, and 3b. We found no significant group differences for household size or income between

**Table 3**  
Deduction of manually grouped modality styles based on hierarchical and TwoStep clustering.

Hierarchical clustering	Committed cyclists	“Die-hard” car drivers	Public-transport-users only to work		General public-transport-users	Mixed private transport users	– / –
TwoStep clustering	Committed cyclists	“Die-hard” car drivers	Public-transport-users to work/free time cycling	Public-transport-users to work/free time car	Outliers (108)		
Manual grouping	Committed cyclists	“Die-hard” car drivers	Public transport users (work)			Mixed private transport users	Outliers (14)

the four modality styles. However, accounting for residential location revealed that households in Borup are comparatively bigger (number of children), and correspondingly with lower income per person. The *public transport users – Borup* (2b) have the lowest income and the biggest household size.

The distribution of number of cars per households is as the modality styles would suggest: Groups 1 and 2 have significantly fewer cars than groups 3 and 4. This is overlain by a significant difference in car ownership between Østerbro and Borup, i.e. groups 1 and 2a have significantly fewer cars than groups 2b, 3a, 3b, and 4. Interestingly, the number of cars among the *public transport users – Østerbro* (2a) is even lower than among the *committed cyclists* (1).

The distances to workplace relate directly to modality styles: *Committed cyclists* have the shortest mean distance (4.60 km) compared to “die-hard” car drivers with the longest (36.43 km, see supplementary material). Obviously, distance to workplace also relates directly to residential location with the Borup-groups (2b, 3b, 4) showing significantly higher distances than the Østerbro-groups (1, 2a, 3a).

If people had moved within the last five years, they were asked about their former residential location. For groups 1, 2, and 4 the share of earlier locations (urban vs. non-urban) is largely corresponding to the current composition of these groups by Østerbro and Borup residents. However, group 3, which consists of residents almost equally from Østerbro and Borup (see Table 4), has a significantly high share of incomers from non-urban settings.

#### 4.3. Holidays and longer weekend trips

Comparing the differences between the modality styles in terms of number of holidays and longer weekend trips, the results revealed a very distinct pattern (see \*) significant group differences ( $p < 0.05$ ); (\*,y,z) significantly different from group x, y and z: *Committed cyclists* account in all trip categories, for which significant group differences could be found, for the significantly highest number of trips; except, only group 3a scores higher for number of holidays elsewhere in Europe.

On the other hand, group 2b (*public transport users – Borup*) is in all trip categories among the groups with the significantly fewest trips; and group 3b (*mixed private transport users – Borup*) scores significantly low for number of holidays. This might be associated with the groups' socio-economic characteristics: 2b and 3b have the biggest household size and the lowest income per person (see Table 5). Hence, there is a tendency for more trips among the residents of Østerbro compared to the residents of Borup (Table 6).

An interesting position is taken by group 4: In terms of weekend trips outside Denmark it shows almost as high frequencies (mean rank = 177.073) as group 1 (180.807), whereas in terms of holidays it is located between the Østerbro and Borup scores, i.e. the “die-hard” drivers undertook weekend trips outside Denmark almost as frequently as the cyclists but went on comparatively less holidays.

Comparing transport modes for weekend trips in Denmark (see Table 7) disclosed significant differences between groups 1 and 2a versus groups 3 and 4, showing reciprocity between public transport and car use. Groups 3 and 4 used almost exclusively (> 90%) the car for their last weekend trip, which can be associated with car ownership (see Table 5) and corresponds to their modality style. However, also

**Table 4**  
Identified modality style-groups.

		Group 1 committed cyclists		Group 2 public transport users (work)		Group 3 mixed private transport users		Group 4 “Die-hard” car drivers	
Total N in each group		96		110		64		55	
Primary transport mode to work		N	%	N	%	N	%	N	%
	Work/stay at home	0	0.0%	0	0.0%	5	7.8%	0	0.0%
Multiple transport modes to free-time activities	Walking	0	0.0%	0	0.0%	6	9.4%	0	0.0%
	Cycling	96	100.0%	0	0.0%	8	12.5%	0	0.0%
	Car	0	0.0%	0	0.0%	35	54.7%	55	100.0%
	Public transport	0	0.0%	110	100.0%	0	0.0%	0	0.0%
	Other <sup>a</sup>	0	0.0%	0	0.0%	10	15.6%	0	0.0%
	Walking	11	11.5%	36	32.7%	37	57.8%	0	0.0%
Residential location	Cycling	96	100.0%	54	49.1%	30	46.9%	0	0.0%
	Car	5	5.2%	38	34.5%	27	42.2%	55	100.0%
	Public transport	12	12.5%	33	30.0%	0	0.0%	0	0.0%
	Other <sup>b</sup>	1	1.0%	3	2.7%	5	7.8%	0	0.0%
Residential location	Østerbro	93	96.9%	53	48.2%	28	43.8%	13	23.6%
	Borup	3	3.1%	57	51.8%	36	56.3%	42	76.4%

<sup>a</sup> Non-distinctive or rare combinations of walking, cycling, motorbike, car and plane.

<sup>b</sup> e.g. motorbike, carpool, plane.

60% of the *committed cyclists* (1), who never use the car to get to work and almost never in their daily free time (5.2%), used a car for their last weekend trip. Contrarily, among the *public transport users* > 85% of the

Borup residents (2b) but < 45% of the Østerbro residents (2a) used a car for their last weekend trip in Denmark; the latter appear to stick to public transport (46.8%) also for weekend trips in Denmark/Skåne.

**Table 5**  
Socio-economic and socio-demographic group differences.

		1 Committed cyclists		2 Public transport users (work)				3 Mixed private transport users				4 “Die-hard” car drivers	
				2a Østerbro		2b Borup		3a Østerbro		3b Borup			
Total N in each group		96		53		57		28		36		55	
Gender		N	%	N	%	N	%	N	%	N	%	N	%
	Female	74	77%	35	66%	23	40%	15	54%	19	53%	28	51%
Education level <sup>a</sup>	Male	22	23%	18	34%	34	60%	13	46%	17	47%	27	49%
	Mean	2.77 <sup>(2a,2b,3b)</sup>		2.45 <sup>(1)</sup>		2.36 <sup>(1)</sup>		2.48		2.46 <sup>(1)</sup>		2.61	
Household size <sup>a</sup>	N	93		51		56		27		35		51	
	Mean rank	183.919		143.157		138.429		146.870		138.729		160.049	
Number of children per HH <sup>a</sup>	Mean	1.72 <sup>(2b)</sup>		1.69 <sup>(2b)</sup>		1.98 <sup>(1,2a,3a)</sup>		1.69 <sup>(2b)</sup>		1.69		1.71	
	N	87		48		55		26		35		49	
Household form	Mean rank	138.264		123.896		193.655		129.577		159.114		154.796	
	Mean	0.52 <sup>(2b)</sup>		0.35 <sup>(2b)</sup>		1.07 <sup>(1,2a,3a)</sup>		0.42 <sup>(2b)</sup>		0.80		0.78	
Household form	N	87		48		55		26		35		49	
	Mean rank	135.155		127.604		187.964		131.115		162.686		159.704	
Ln income/person <sup>a</sup>	Single <sup>a</sup>	25	32%	20 <sup>(2b)</sup>	48%	8 <sup>(2a)</sup>	18%	8	33%	6	18%	13	30%
	Single with ≥ 1 children	8	10%	3	7%	4	9%	2	8%	6	18%	6	14%
No. of cars per household <sup>a</sup>	Couple	29	37%	11	26%	9	20%	10	42%	11	32%	12	27%
	Couple with ≥ 1 children <sup>a</sup>	17 <sup>(2b)</sup>	22%	8 <sup>(2b)</sup>	19%	24 <sup>(1,2a,3a)</sup>	53%	4 <sup>(2b)</sup>	17%	11	32%	13	30%
Ln work distance <sup>a</sup>	Median	12.666		12.766		12.286 <sup>(3a)</sup>		12.766 <sup>(2b)</sup>		12.429		12.595	
	N	73		41		51		24		31		44	
Location before moving <sup>a</sup>	Mean rank	140.575		143.451		104.324		166.167		117.532		133.739	
	Mean	0.53 <sup>(3,4)</sup>		0.72 <sup>(3,4)</sup>		0.72 <sup>(3,4)</sup>		1.27 <sup>(1,2)</sup>		1.27 <sup>(1,2)</sup>		1.51 <sup>(1,2)</sup>	
Ln income/person <sup>a</sup>	N	96		110		110		64		64		55	
	Mean rank	117.531		140.595		104.324		207.172		207.172		235.773	
No. of cars per household <sup>a</sup>	Mean	0.53 <sup>(2b,3a,3b,4)</sup>		0.36 <sup>(2b,3a,3b,4)</sup>		1.05 <sup>(1,2a,4)</sup>		1.00 <sup>(1,2a)</sup>		1.47 <sup>(1,2a)</sup>		1.51 <sup>(1,2a,2b)</sup>	
	N	96		53.0		57		28		36		55	
Ln work distance <sup>a</sup>	Mean rank	117.531		95.802		182.246		176.839		230.764		235.773	
	Median	1.792 <sup>(2,3,4)</sup>		3.219 <sup>(1,3)</sup>				2.996 <sup>(1,2,4)</sup>				3.555 <sup>(1,3)</sup>	
Location before moving <sup>a</sup>	N	96		108				62				55	
	Mean rank	80.130		202.278		4.007 <sup>(1,2a,3a)</sup>		160.516		3.638 <sup>(1,2a,3a)</sup>		221.645	
Location before moving <sup>a</sup>	Median	1.792 <sup>(2,3,4)</sup>		1.841 <sup>(1,2b,3b,4)</sup>				1.792 <sup>(2b,3b,4)</sup>				3.555 <sup>(1,2a,3a)</sup>	
	N	96		51		57		28		34		55	
	Mean rank	80.130		140.735		257.342		102.214		208.529		221.645	
Location before moving <sup>a</sup>		N	%	N	%			N	%			N	%
	Urban	22 <sup>(3,4)</sup>	88%	18 <sup>(3)</sup>	58%			4 <sup>(1,2)</sup>	19%			3 <sup>(1)</sup>	23%
	Non-urban	3	12%	13	42%			17	81%			10	77%

(x,y,z) significantly different from group x, y and z.

<sup>a</sup> Significant group differences ( $p < 0.05$ ).

**Table 6**

Group differences related to number of weekend and holiday trips.

		1 Committed cyclists	2 Public transport users (work)		3 Mixed private transport users		4 “Die-hard” car drivers
			2a Østerbro	2b Borup	3a Østerbro	3b Borup	
Total N in each group		96	53	57	28	36	55
No. of weekend trips (max. 3 nights) outside Dk <sup>a</sup>	Mean	1.35 <sup>(2)</sup>	0.85 <sup>(1)</sup>		0.91		1.24
	N	96	110		64		55
	Mean rank	180.807	146.600		152.383		177.073
	Mean	1.35 <sup>(2b)</sup>	1.11	0.60 <sup>(1)</sup>	1.18	0.69	1.24
	N	96	53	57	28	36	55
No. of holidays (> 3 nights) elsewhere in Europe <sup>a</sup>	Mean rank	180.807	165.236	129.272	173.589	135.889	177.073
	Mean	1.36 <sup>(2)</sup>	0.73 <sup>(1)</sup>		0.91		0.76
	N	89	101		57		50
	Mean rank	171.410	134.183		147.123		141.180
	Mean	1.36 <sup>(2b,3b)</sup>	0.81	0.66 <sup>(1)</sup>	1.38 <sup>(3b)</sup>	0.52 <sup>(1,3a)</sup>	0.76
Total No. of holidays (> 3 nights) <sup>a</sup>	N	89	48	53	26	31	50
	Mean rank	171.410	139.750	129.142	181.981	117.887	141.180
	Mean	3.29 <sup>(2,3)</sup>	1.95 <sup>(1)</sup>		2.28 <sup>(1)</sup>		2.36
	N	89	101		57		50
	Mean rank	184.022	128.777		132.105		146.770
	Mean	3.29 <sup>(2a,2b,3b)</sup>	1.94 <sup>(1)</sup>	1.96 <sup>(1)</sup>	2.69	1.94 <sup>(1)</sup>	2.36
	N	89	48	53	26	31	50
	Mean rank	184.022	130.052	127.623	146.058	120.403	146.770

(x,y,z) significantly different from group x, y and z.

<sup>a</sup> Significant group differences ( $p < 0.05$ ).

When looking at weekend trips outside Denmark, group 2b shows, similar to trips in Denmark, even the highest share of car use (contrary the lowest share of plane use, together with group 3b). This might again be associated with the comparatively big household size and lower income of these two groups, as plane trips are more expensive and also cumbersome with children (similar to using public transport). However, due to a low number of responses with weekend trips outside Denmark, the differences in plane trips could not be qualified as statistically significant.

Looking at the transport modes for holidays, we found a similar reciprocal share of trips by public transport or car, respectively, between groups 1 and 2a versus 4 (and 3b) as for weekend trips in

Denmark. Plane use for holidays is largely consistent with plane use for weekend trips; groups 1 and 3a (both Østerbro) used the plane significantly most often.

Accordingly, the total number of private plane trips (weekend trips and holidays) is significantly highest among the *committed cyclists* (1) and lowest among the public transports users and mixed private transport users from Borup, respectively.

#### 4.4. Attitudes

Using people's travel-related attitudes (see Table 8) for contrasting their self-reported travel behaviour revealed a twofold result: We found

**Table 7**

Group differences related to mode choice for weekend trips and holidays.

		1 Committed cyclists	2 Public transport users (work)		3 Mixed private transport users		4 “Die-hard” car drivers
			2a Østerbro	2b Borup	3a Østerbro	3b Borup	
Total N in each group		96	53	57	28	36	55
Last weekend trip in Dk by ... <sup>b</sup>	N						
	Car <sup>a</sup>	48 <sup>(3b,4)</sup>	21 <sup>(2b3a,3b,4)</sup>	36 <sup>(2a)</sup>	21 <sup>(2a)</sup>	27 <sup>(1,2a)</sup>	44 <sup>(1,2a)</sup>
	Public transport <sup>a</sup>	27 <sup>(3b,4)</sup>	22 <sup>(2b,3a,3b,4)</sup>	6 <sup>(2a)</sup>	2 <sup>(2a)</sup>	1 <sup>(1,2a)</sup>	1 <sup>(1,2a)</sup>
	%	60.0%	44.7%	85.7%	91.3%	93.1%	93.6%
	%	33.8%	46.8%	14.3%	8.7%	3.4%	2.1%
Last weekend trip outside Dk by ... <sup>b</sup>	N						
	Car <sup>a</sup>	14 <sup>(2b)</sup>	6 <sup>(2b)</sup>	14 <sup>(1,2a)</sup>	6	8	18
	Public transport	9	4	0	0	1	0
	%	22.6%	18.8%	63.6%	35.3%	53.3%	51.4%
	%	14.5%	12.5%	0.0%	0.0%	6.7%	0.0%
No. car use to holidays <sup>a</sup>	N						
	Median	0.5 <sup>(4)</sup>	0.0 <sup>(4)</sup>	1.0	1.0	1.0	1.0 <sup>(1,2a)</sup>
	N	84	39	45	22	28	44
	Mean rank	113.369	103.013	146.067	128.568	152.018	164.875
	%	58.1%	62.5%	31.8%	58.8%	26.7%	40.0%
No. bus/train use to holidays <sup>a</sup>	N						
	Median	0.0 <sup>(3b,4)</sup>	0.0 <sup>(4)</sup>	0.0	0.0	0.0 <sup>(1)</sup>	0.0 <sup>(1,2a)</sup>
	N	84	39	45	22	28	44
	Mean rank	151.798	146.590	129.778	116.636	107.250	104.000
	%	14.5%	12.5%	0.0%	0.0%	0.0%	0.0%
No. plane use to holidays <sup>a</sup>	N						
	Median	1.0 <sup>(3b,4)</sup>	1.0	1.0	1.0 <sup>(3b,4)</sup>	0.5 <sup>(1,3a)</sup>	1.0 <sup>(1,3a)</sup>
	N	84	39	45	22	28	44
	Mean rank	150.726	144.744	113.422	164.864	94.500	108.409
	%	14.5%	12.5%	0.0%	0.0%	0.0%	0.0%
Total No. of private plane trips <sup>a</sup>	N						
	Median	1.0 <sup>(2b,3b)</sup>	1.0	1.0 <sup>(1)</sup>	1.0	1.0 <sup>(1)</sup>	1.0
	N	93	51	57	27	35	52
	Mean rank	179.774	168.402	133.921	184.463	123.314	144.856

(x,y,z) significantly different from group x, y and z.

<sup>a</sup> Significant group differences ( $p < 0.05$ ).<sup>b</sup> Contains cells with expected counts < 5.

**Table 8**  
Group differences related to travel-related attitudes.

		1 Committed cyclists	2 Public transport users (work)		3 Mixed private transport users		4 “Die-hard” car drivers
			2a Østerbro	2b Borup	3a Østerbro	3b Borup	
Total N in each group		96	53	57	28	36	55
“Car – freedom” <sup>a</sup>	Median	1.0	1.0 <sup>(3b,4)</sup>	1.0	1.0	1.0 <sup>(2a)</sup>	1.0 <sup>(2a)</sup>
	N	44	17	49	24	33	52
	Mean rank	117.477	132.647	108.939	108.917	103.242	102.058
“Environmentally friendly daily transport” <sup>a</sup>	Median	1.0 <sup>(2,3,4)</sup>	1.0 <sup>(1,4)</sup>		2.0 <sup>(1)</sup>		2.0 <sup>(1,2)</sup>
	N	93	108		62		52
	Mean rank	112.602	159.139		175.839		215.558
“Environmentally friendly weekend/holiday transport” <sup>a</sup>	Median	2.0 <sup>(4)</sup>	2.0		2.0		2.0 <sup>(1)</sup>
	N	93	108		62		52
	Mean rank	139.151	161.259		158.081		184.846
“Trips are important” <sup>a</sup>	Median	1.0 <sup>(2b,3b)</sup>	1.0	1.0 <sup>(1)</sup>	1.0	1.0 <sup>(1)</sup>	1.0
	N	93	51	57	27	35	52
	Mean rank	141.952	150.206	181.868	151.074	191.000	149.567

(x,y,z) significantly different from group x, y and z.

<sup>a</sup> Significant group differences ( $p < 0.05$ ).

that in terms of owning a car and eco-friendliness of daily mode choice, the stated attitudes largely conform to reported behaviour and corresponding modality styles:

The modality styles with the highest car ownership (groups 3b and 4; see Table 5) agree most with the statement “Owning a car gives me freedom to go where- and whenever I want.”, whereas the group with the lowest car ownership (2a) stated the least agreement with this statement.<sup>2</sup>

In terms of eco-friendly daily transport modes, the stated attitudes are coherent with the respective modality styles: *Committed cyclists* agree most with a “green” attitude, whereas *mixed private transport users* and *“die-hard” car drivers* agree the least.

The attitudes regarding weekend and holiday travel, however, conform only to some extent to behaviour:

With regards to the importance of holidays and longer weekend trips, the reported trip numbers are in accordance with the stated attitudes: *Committed cyclists* (1) stated significantly highest importance and accordingly went most frequently on trips, whereas groups 2b and 3b (both Borup) stated the lowest importance and accordingly undertook the fewest trips. This suggests that a combination of the factors income, household size and attitude explain the limited travel activity of groups 2b and 3b.

However, when it comes to the eco-friendliness of transport modes to holidays and longer weekend trips we found discrepancies between attitudes and behaviour: “*Die-hard*” car drivers give least importance to eco-friendly transport and used the car correspondingly most often; however, they instead rarely used a plane. In contrast, *committed cyclists*, who stated the highest importance for eco-friendly transport, used (together with group 2a) public transport relatively often, but on the other hand, they used the plane comparatively most often; and for weekend trips in Denmark, they also used the car. Obviously, the *committed cyclists*’ attitudes are contradictory to their travel behaviour, particularly in terms of plane use.

## 5. Discussion

### 5.1. Modality styles and urban structure

Grouping the sample of residents from Østerbro and Borup based on daily transport mode choice revealed four distinct modality styles: *Committed cyclists*, *public transport users*, *mixed private transport users* and “*die-hard*” car drivers. Two of them, *committed cyclists* and “*die-hard*” car

*drivers*, are primarily represented in Østerbro and Borup, respectively, indicating a predominant modality style in each case area. Østerbro is representing Copenhagen’s cycling culture (e.g. Carstensen and Ebert, 2012). A recent study (Prato et al., 2016) that investigated transport mode choices from a lifestyle perspective, also in the Copenhagen Region, largely confirms our results: The study arrived to four similar groups: *car oriented*, *bicycle oriented*, *public transport oriented*, and *public transport averse* with corresponding differences in residential location (centre vs. surroundings of Copenhagen). Also Olafsson et al. (2016) found that cycle-based daily travel predominantly takes place in larger urban areas, whereas car-based transport is dominant in small urban/suburban areas. Olafsson et al. (2016) found, though, that the travel behaviour of Danes is more multimodal than our findings reveal. These deviations are likely explained by the data collection methods, as we asked how people “mostly” get to work/education/free-time activities, whereas Olafsson et al. (2016) inquired the number of days respondents used different transport modes over the course of one week. Furthermore, the here identified groups *public transport users* and *mixed private transport users* are multimodal.

The study’s identified modality styles confirm the relevance of urban structure for daily travel mode choice (e.g. Næss, 2006a) as represented by the two distinct case areas. However, *public transport users* and *mixed private transport users* are equally represented in both case areas; this indicates the relevance of further factors for the establishment of modality styles, such as car ownership, household size, income, or “imported” travel behaviour. The significant amount of people among the *mixed private transport users* who moved in from non-urban settings indicates that some people might “import” their past travel disposition (see Klinger and Lanzendorf, 2016) and do not necessarily adopt the new setting’s predominant modality style; representing *residential mismatch* (de Vos et al., 2012; Schwanen and Mokhtarian, 2005b).

### 5.2. Modality styles and weekend/holiday travel behaviour

When relating daily modality styles to the frequency of and transport mode choices to holidays and weekend trips, it appears that differences are explained at two levels, by accounting for modality styles and residential location, as shown when splitting the *public transport users* and *mixed private transport users* into their Østerbro/Borup subsample.

Overall, *committed cyclists* most frequently undertook longer weekend trips and holidays, and in general, there is a tendency for more trips among respondents from Østerbro.

In terms of transport modes, the “*die-hard*” drivers stick to the car also for weekend/holiday travel. *Public transport users* – Østerbro and *committed cyclists* have the fewest cars and used them least often for

<sup>2</sup> Note: Only households who stated that they owned at least one car were asked about this attitude.

weekend trips/holidays; however, the car still accounts for a considerable share (60%) of weekend trips in Denmark among *committed cyclists*. *Public transport users* manifest the relevance of residential location by behaving like their “residential peers”: Those from Østerbro tend to use the plane and to a certain extent public transport for weekend trips/holidays; those from Borup predominantly use the car. Except for weekend trips in Denmark among *public transport users* – Østerbro, the use of public transport plays a minor role for weekend trips and holidays, as also confirmed by a previous study on Danes' travel behaviour (Christensen, 2014).

Overall, it appears that “*die-hard*” drivers avoid using modes other than the car; they hardly use public transport, and apparently use a plane only when it is inevitable (e.g., for weekend trips outside Denmark<sup>3</sup>). *Cyclists*, who travel “greenest” in daily life, use the plane most often. Overall, plane use is lower in Borup than in Østerbro, i.e. significant group differences emerged only when accounting for residential location (see Table 7). These findings are in line with those of Prillwitz and Barr (2011), who arrived to similar results, particularly for the “green” daily travellers.

According to our results, *car drivers* and *cyclists* – and to a certain extent *public transport users* – tend to use one main transport mode for daily travel. If this transport mode is suitable (e.g., car, public transport) it is to a certain extent transferred for weekend/holiday travel. However, if the main transport mode (e.g., cycling) is not suitable, which is usually the case for non-motorised modes, its users switch even more than the first group to unsustainable modes such as planes. Our study does not, however, assess the effect of accessibility to an airport and cheap flights on the one hand, compared to the high expenses of owning a car in Denmark on the other hand, which presumably affects mode choices for weekend trips and holidays.

In summary, we observe interdependency between modality style, residential location, car ownership/use, and plane use for weekend/holiday travel. People in urban areas have less access to cars, but instead use planes more often. People in peri-urban areas have in contrast more access to cars (and less to an airport) and consistent with their daily mode choice, predominantly use the car, which is line with the findings of Lanzendorf (2002).

The contrast between daily travel patterns and travel behaviour of holidays and weekend trips has been further illustrated by looking at the respondents' attitudes: In terms of owning a car, eco-friendliness of daily transport, and importance of holidays and weekend trips, the attitudes are largely in accordance with behaviour for all modality styles. However, when it comes to mode choice for holidays and weekend trips, particularly the *committed cyclists* “behave” rather contrary to their eco-friendly attitude, especially regarding plane use. On the other hand, the “*die-hard*” car drivers' comparatively low eco-commitment is more in line with their behaviour.

This discrepancy between behaviour and attitudes is confirmed by previous studies that found that people “find it difficult to align their behaviour with their environmental attitudes during their leisure time” (Holden and Linnerud, 2011, p. 3099) and that assessed limited influence of environmental attitudes on non-daily leisure travel behaviour (Böhler et al., 2006; Holden, 2007; Prillwitz and Barr, 2011).

### 5.3. Urban structure and weekend/holiday travel behaviour

Relating the four modality styles to holiday and weekend travel behaviour suggests at first glance a “reverse” effect of urban structure: The eco-friendly daily travel behaviour of the urban *cyclists* and *public transport users* is replaced by environmentally harmful transport modes and comparatively high frequencies of holidays and weekend trips. This

observation raises questions regarding the extent to which such travel behaviour may be “compensatory”. The *compensation hypothesis* suggests that dense and compact living may stimulate increased leisure travel in order to compensate for the disadvantages of density (see Holden and Norland, 2005; Maat and de Vries, 2006; Næss, 2006b; Vilhelmson, 1990).

However, the attitudes stated by the respondents in terms of importance of trips (stronger agreement in Østerbro) as well as the socio-economic and socio-demographic differences (lower income, bigger household sizes in Borup), indicate that the observed differences in holiday and weekend travel behaviour originate predominantly in other factors such as family status, life stage or disposable income (i.e. lifestyle orientations) that are manifested in different travel behaviour (i.e. lifestyle expressions) (see van Acker et al., 2016). Böhler et al. (2006) likewise found that trip activity is associated with socio-economic and socio-demographic factors such as household type.

Additionally, we can assume that certain lifestyles are predominant in certain residential locations since lifestyles and related preferences influence residential choices (Salomon and Ben-Akiva, 1983). This is demonstrated in the trend of young families moving outside central Copenhagen (Aner, 2016; Fertner, 2013) and is confirmed by our data. The data does not explicitly control for residential self-selection because suitable questions, e.g., related to recent moving, did not achieve sufficiently high turnout rates. However, the stated reasons for moving are mainly “size/quality of the living space”, “affordability/price” and/or “change of family situation”; whereas travel/accessibility-related reasons play a minor role, only among a small number of respondents (42% = 5 respondents) who moved from non-urban settings to Østerbro (11.5% of all respondents who have moved within the last 5 years).

This link between lifestyle, residential choices and travel behaviour has been conceptualised as ‘extended choice hierarchy’ by Salomon and Ben-Akiva (1983): travel behaviour is considered a *short-term decision* and residential location a *mid-term decision*, both of which fulfil *long-term lifestyle decisions*. Accordingly, lifestyle has a *behavioural* and a *residential* representation.

Consequently, holiday and weekend travel behaviour is not primarily explained by urban structure but rather by factors that affect residential choices and represent certain lifestyles. The fact that residential location is a proxy for such factors must not be confused with evidence concerning the direct influence of urban structure. A link between urban living and a “cosmopolitan” lifestyle expressed in more extensive and more distant leisure travel has also been suggested in previous studies (e.g. Holden and Norland, 2005; Næss, 2016; Næss, 2006b; Næss, 2005; Reichert et al., 2016).

However, neither can a direct effect of urban structure on weekend/holiday travel be excluded.

### 5.4. Limitations of the study

Our study encountered limitations with regards to a limited number of respondents due to the applied sampling strategies. Although the response rates are considered sufficient with respect to the population size in both case areas, less sophisticated statistical methods that do not account for multivariate relationships across the included factors have been applied with respect to the sample size and in order to receive reliable results. Further, the different sampling strategies applied in the two areas may have influenced the kind of people (e.g. regarding age) that participated in each area and thereby increased the differences between the two samples.

Furthermore, the soundness of results and related conclusions concerning attitudes is limited due to the applied operationalisation of attitudes, which included only one question for each attitude. Attitude-related questions are particularly prone to bias as they are rooted in a cognitive process and thereby affected by context (Meyburg and Metcalf, 2000; Prillwitz and Barr, 2011; Tourangeau and Rasinski,

<sup>3</sup> Transport mode choices for weekend trips outside Denmark might be more restricted due to distance and limited time (only weekend), many destinations are only reachable by plane.

1988). Therefore, in attitude-focused surveys, attitudes are usually validated by multiple questions to reflect one attitude. However, other sources of bias, such as conducting a survey as a personal interview (Meyburg and Metcalf, 2000), are ruled out.

Further limitations arise from the use of cross-sectional data that does not allow for the assessment of changes in travel behaviour over time (Lavrakas, 2008). As travel behaviour is also an expression of lifestyle, the dynamic character of lifestyles (see van Acker et al., 2016), e.g., changes in family situation, residential choices or desire to travel, cannot be represented. Furthermore, a certain seasonal bias cannot be totally ruled out, although the design of the questions sought to avoid that.

## 6. Conclusions and perspectives

We can assert that the urban structure of a residential location (e.g., urban vs. peri-urban) affects to some extent the constitution of daily modality styles; however, the mixed representation of *public transport users* and *mixed private transport users* indicates the importance of further factors.

When relating the identified modality styles to the frequency of and transport mode choices to holidays and longer weekend trips, we establish a link by including residential location as an additional layer. This link is understood when looking into socio-economic and socio-demographic factors as well as travel-related attitudes. Hence, our findings support the notion of modality styles as expressions of mobility styles (Vij et al., 2013), as they illustrate the link between travel behaviour and factors, such as socio-economic factors or attitudes, that underlie residential location.

Consequently, according to our findings, residential location has a somewhat paradoxical role: For daily travel, the urban structure of a residential location exerts important influence on travel behaviour; however, in terms of travel behaviour on holidays and weekend trips, residential location presumably rather serves as a proxy for certain lifestyles or people with certain socio-economic and socio-demographic characteristics.

Our study does not allow for comparing the four modality styles in terms of the effective environmental impact of their travel behaviour. However, obviously their impacts differ in daily travel, but when travel behaviour on holidays and weekend trips is included the four modality styles close ranks.

The discrepancy between daily travel patterns and weekend/holiday travel behaviour, which is also found in previous studies (e.g. Barr and Prillwitz, 2012; Prillwitz and Barr, 2011), requires increased attention in spatial development and transport policies. It appears that policies tailored for sustainable everyday travel have little or even adverse effects on certain leisure travel (Holden and Linnerud, 2011). For instance, limited expenses for daily travel (e.g., when cycling) may increase the disposable budget for weekend and holiday travelling, after all. Thus, policies that address travel behaviour comprehensively as well as such that tackle particularly weekend and holiday travel are needed.

What makes people travel more sustainably? In daily life it is probably not only an eco-friendly attitude of the residents of Østerbro, but the fact that cycling is the most efficient way to move within Copenhagen. The weekend/holiday travel behaviour of the same group confirms that attitudes hardly affect travel mode (plane, car) choices.

Our results suggest that public transport is currently underutilised for weekend/holiday travel; thus, additional research is required on what prevents people from using it and what kinds of transport policies are needed for making public transport, e.g., in terms of speed, convenience, price, a competitive choice compared to car or plane use, at least for short- and medium-distance trips. Suggestions include multi-modal travel passes (e.g. Sauter-Servaes and Nash, 2009) that allow combining different types of public transport, car sharing systems, and public bicycle schemes. Furthermore, in Europe, reactivating attractive

night train connections instead of continuing their shutdown could offer competitive alternatives to plane use, in terms of time efficiency and price. The recent revival of long-distance coach services in Western Europe, due to their uptake by private companies, expresses a demand for public transport alternatives. Although long-distance coaches can compete with planes on price, they are only competitive to a limited extent in terms of time efficiency and comfort. Yet, improvements to the reputation and perception of public transport are also crucial; the idea of a free InterRail pass sponsored by the European Union for all 18-years-olds (Calder, 2016) appears ground-breaking.

Although our study did not focus on establishing differences in the environmental impact of holidays and weekend trips related to, for instance, travel distance, the results indicate that city dwellers undertake more distant trips (e.g., holidays to Europe outside Scandinavia). Current travel trends thus need to be assessed in terms of destination choices as these directly affect travel mode choices, especially for long distances, where planes are often the only option. Previous studies provide evidence that there are similarities in holidaymakers' socio-economic, socio-demographic and lifestyle-related factors for certain types of holidays (e.g. Götz, 2004). Types of holidays as well as background information on the holidaymakers may provide a relevant starting point for developing interventions to change travel behaviour; e.g., if the purpose of a holiday is to spend time at the beach, which forms the biggest group of holiday types (Götz, 2004), this does not require flying overseas but may be substituted by less-distant destinations.

Finally, policies that set economic or regulative constraints appear inevitable, especially with regards to long-distance travel. Road-pricing (Klinger and Lanzendorf, 2016), a personal carbon budget (Prillwitz and Barr, 2011), or CO<sub>2</sub>-emission charges (Holden and Linnerud, 2011) are only a few suggestions worth investigating. This, however, also requires widening the focus of transport planning agendas and travel behaviour research more towards long-distance travel.

## Conflicts of interest

The authors declare that there is no conflict of interests.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jtrangeo.2018.04.008>.

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